

Claims

Sub A3
1. In a confocal microscope having a probe section and an imaging section in which light for illuminating a region of interest viewed at the probe section is generated and, an image is constructed from remitted light from the region, the improvement comprising a flexible incoherent optical coupling element in at least one of said sections.

2. The microscope according to Claim 1 wherein said element is an incoherent fiber optic bundle.

Sub C2
3. The microscope according to Claim 2 wherein said imaging section comprises a line scanning means which scans across a proximal end of the element.

4. The microscope according to Claim 3 further comprising a slit aperture disposed in the path of light scanned by said means across said proximal end.

5. The microscope according to Claim 2 further comprising an objective lens at a distal end of said element for focusing a laser beam in said region.

Sub A4
6. A confocal microscope comprising a fiber bundle coupling between a light manipulation section and an objective lens, in which the fiber bundle scrambles light incident said fiber bundle.

Sub C4
7. The microscope according to Claim 6 wherein said fiber bundle has two ends and said microscope further comprises a confocal mask at one of said ends near said manipulating section of the fiber bundle to enhance confocality.

Sub A5
8. The microscope according to Claim 6 wherein the fiber bundle is not coherent in that spatial individual fibers at one of said ends of the bundle is scrambled relative to that at the other of said ends.

9. The microscope according to Claim 8 wherein said individual fibers are scrambled randomly.

10. The microscope according to Claim 8 wherein said individual fibers are scrambled in a prescribed pattern.

11. The microscope according to Claim 6 wherein the incident light forms a line.

12. The microscope according to Claim 7 wherein said confocal mask is a slit.

13. The microscope according to Claim 6 wherein said fiber bundle has a distal end and light from the distal end of the fiber bundle is imaged by said objective lens onto a sample, and remitted light from the sample is collected by said objective lens and coupled back into the fiber bundle.

14. The microscope according to Claim 6 in which each end of the fiber bundle is index matched via a window material to reduce reflection from fiber ends.

15. A method for decoding a scrambled image formed by an incoherent fiber bundle in a microscope comprising the steps of:
raster scanning a focused light spot onto one end of the fiber bundle; and
sequentially reading out the corresponding fiber at the other end of said bundle.

16. The method according to Claim 15 wherein said incoherent fiber bundle represents a first fiber bundle, and said method further comprises the step of decoding the scrambled image formed by said first fiber bundle with a second incoherent fiber bundle.

17. A method for decoding the scrambled image formed by the incoherent fiber bundle in a microscope comprising the steps of:

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illuminating one end of the bundle with a spatially coded or a color-coded line pattern;
and
imaging the corresponding fibers at the other end of said bundle.

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18. The method according to Claim 17 wherein said spatially coded pattern is a binary masked pattern.

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19. The method according to Claim 17 wherein said incoherent fiber bundle represents a first fiber bundle, and said method further comprises the step of decoding the scrambled image formed by said first fiber bundle with a second incoherent fiber bundle.

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